Reunion, ought to be regarded as a, probably local, variety of *Pal. lar* Fabr.

The male from Christmas Island bears a *close* resemblance, indeed, to *Pal. altifrons* Hend. from British India (Delhi, River Jumna, Lahore), described and figured in Trans. Linnean Soc., 2nd ser. Zool. vol. v. 1893, p. 444, pl. 40. figs. 4–6. The carapace of *Pal. altifrons* is, however, slightly *scabriculate* anteriorly, and the rostrum appears *considerably higher* above the lateral carina than below it and than in the specimens from Christmas Island; the carpus of the 2nd legs, finally, has also a less stout shape.

EXPLANATION OF THE PLATES.

PLATE XVII.

Fig. 1. *Ptychognathus pusillus* Heller, male from Christmas Island, × 2. Fig. 2. Front, epistome &c., viewed from before, × 3. Fig. 3. External maxillipede of the right side, × 3. Fig. 4. Abdomen, × 3. Fig. 5. Chela viewed from the outer side, × 3.

    6. *Ptychognathus barbatus* A. M.-Edw., male from Atjeh, the cephalothorax of which is 10·2 mm. broad; anterior half of the upper surface, × 3.

PLATE XVIII.

Fig. 7. *Palæmon (Eupalæmon) lar* Fabr. var. ?. rostrum of the male from Christmas Island, × 2. Fig. 8, left, fig. 9, right leg of the 2nd pair of the male, × 2. Fig. 10. Toothing of the fingers of the left leg, × 8. Fig. 11. Leg of the 3rd pair of the male, × 2. Fig. 12. Rostrum of the female from Christmas Island, × 2. Fig. 13. Left leg of the 2nd pair of this female, × 2. Fig. 14. Toothing of same leg, × 17. Fig. 15. Leg of the 3rd pair of the female, × 4.

    16. *Palæmon (Eupalæmon) lar* Fabr., rostrum of the male from the River Palopo, Celebes, × 2. Fig. 17. Leg of the 2nd pair of the male, × 2. Fig. 18. Toothing of the fingers of same leg, × 17 (the dactylus is a little loose). Fig. 19. Leg of the 3rd pair, × 2.

7. Note on Heredity in Pigeons.
By RICHARD STAPLES-BROWNE, F.Z.S.

[Received November 8, 1905.]

I. THE WEBBED FOOT.

I received in 1902 a Pigeon with webbed feet, and, thinking it would be interesting to investigate the inheritance of this character, I made the following experiments with it.

There is no established strain of web-footed Pigeons, but specimens so webbed are occasionally met with among domestic birds. The character has been found in the Dove-cot Pigeon and Working Homer, also in the Show Homer, Dragon, Magpie, Tippler, Tumbler, Jacobin, and Pouter. I have myself bred birds in the F. 4 generation of a cross between a Barb and a Fantail, which showed this character to a considerable extent.

So far as I can at present judge from specimens recorded by breeders, the most common type is a web between two digits

only on each foot, and it is more usual to find the development of the web nearly symmetrical in the two feet.

It sometimes occurs between digits ii. and iii. sometimes between iii. and iv., and sometimes between all three.

The instances in which it reaches the bases of the claws between all the digits on both feet are rarer. It has occurred on one foot only.

Though this character has been observed to occur in the offspring of normal-footed parents, I have never heard of an instance in which all the young so bred were webbed. It has been found in a pigeon bred from parents of two different strains, and I have also heard of cases in which it occurred from time to time in the same strain, birds showing the character having been discarded.

The general result of the experiments is that the inheritance of the webbed foot is Mendelian.

It is recessive to the normal foot.

The character is not a thoroughly satisfactory one to work with, as it is liable to considerable fluctuation in extent.

Extracted recessives, though all show webbing, have this character in various degrees; in some it reached only to the first interphalangeal joint of the second and third digits, or to the second joint of the fourth digit.

On examining the normal population I find that birds occasionally, though rarely, occur with webs as extensive as this.

In the families here recorded I took the first interphalangeal joint of the second and third digits and the second joint of the fourth digit as a minimum, and counted as " webbed " all birds with a web reaching this minimum in the case of at least two adjoining digits : all birds with less webbing than this being given as normal.

If a much greater series of numbers could be investigated, undoubtedly there would be overlapping between the two classes of normal and webbed birds.

On the other hand, the evidence, so far as it goes, does not indicate that the degree of webbing in the parents closely limits the amount in the offspring, for moderately webbed birds have given birds more webbed, and fully webbed birds have given offspring less webbed (see exp. 13 and 14).

I hope later to make further experiments with the lower states of this condition.

Web-footed ♂ used in Experiments.

The Pigeon which I used in the following experiments somewhat resembled an Antwerp in appearance, but was of no distinct variety. The web extended to the base of the claws in both feet, but the digits were rather closely webbed together except iii. and iv. of the right foot, where the web was sufficiently loose to allow the usual spread of the foot. The bird was of the

ordinary blue colour found in *Columba livia*. The feathers on the back of the head were perfectly smooth (*cf.* Nun Pigeon).

It was bred by Mr. Doggett, of Cambridge, in 1896, from a pair of birds with perfectly normal feet. The parents produced several offspring showing webbing in varying degrees. Three of these birds were exhibited by Mr. Bateson at the Zoological Society, and are described in the 'Proceedings' for Dec. 15th, 1896, p. 989. (The bird used is No. 3 in that description.)

It was also described and the right foot figured by Mr. Tegetmeier in 'The Field' of Sept. 12th, 1896.

It appears that some of these birds were bred together and produced, among others, a bird with completely webbed feet, the web being sufficiently loose to allow the normal spread of the foot between every digit. This bird was exhibited by Mr. E. S. Montagu at a meeting of the British Ornithologists' Club on Jan. 22nd, 1902. It is described in the report of the meeting (Bull. B. O. C. xii. p. 41), and again in 'The Field' of Feb. 1st, 1902 (vol. xcix. p. 177).

"Nun" Pigeon ♀ used in Experiments.

The Nun is an old established strain of Pigeons, originally a variety of Tumbler. The feet are normal and free from feathering. It exhibits a tuft of reversed feathers standing up at the back of the head forming the "shell." It is slightly larger than the peak found in the Turbit and some similar varieties.

Crosses between the Web-footed Pigeon and the Nun Pigeon.

The experiments were begun in 1902. The original cross was made between one pair of birds only, viz., those described above. The subsequent experiments consisted of breeding from the birds produced by the first cross.

The results of the experiments, so far as they concern the two principal characters of web-foot and "shell," are given in Table I.

The table is arranged in a similar manner to that used by Bateson and Punnett in the description of their experiments with Poultry in the second report to the Evolution Committee of the Royal Society. The ordinary Mendelian terms are used :—

D and R being the original dominants and recessives;

DR is the first hybrid generation or F. 1;

$\dfrac{DR}{2}$ the heterozygote dominant in F. 2;

$\dfrac{DD}{2}$ the homozygote dominant in F. 2; and

$\dfrac{R}{2}$ the extracted recessive.

The same terms over 3 apply to similar forms in F. 3.

The asterisk shows that the bird is bred from a DR × R mating, and not from a DR × DR.

TABLE I.

Exp. No.	♀	Origin from Exp.	Feet.	"Shell."	Also used in Exp.	♂	Origin from Exp.	Feet.	"Shell."	Also used in Exp.	Nature of Mating.	Feet. Normal.	Feet. Webbed.	Nature of Mating.	"Shell." Present.	"Shell." Absent.
1902. 1	Nun	—	N	P	—	Web	Doggett	W	A	2 & 5	$D \times R$	6	0	$R \times D$	0	6
1903. 2	37	1	N	A	—	Web	Doggett	W	A	1 & 5	$DR \times R$	5	4	$DR \times D$	0	8
3	40	1	N	A	6 & 11	41	1	N	A	6 & 12	$DR \times DR$	11	0	$DR \times DR$	2	7
4	39	1	N	A	5	42	1	N	A	—	$DR \times DR$	9	3	$DR \times DR$	3	6
1904. 5	39	1	N	A	4	Web	Doggett	W	A	1 & 2	$DR \times R$	4	5	$DR \times D$	0	9
6 (repetition of 3)	40	1	N	A	3 & 11	41	1	N	A	3 & 12	$DR \times DR$	12	0	$DR \times DR$	1	10
7 (repetition of 3)	30	2	W	A	—	58	2	W	A	—	$\frac{R^*}{2} \times \frac{R^*}{2}$	0	5	$\left[\frac{DR \times DR}{2}\times\frac{R}{2},\ \frac{DR}{2}\times\frac{R}{2}\right]$	1	1
8	31	2	W	A	—	19	2	W	A	14	$\left[\frac{R^*}{2} \times \frac{R^*}{2}\right]$	0	6	—	0	5
9	18	4	N	P	—	24	3	N	P	—	—	7	0	—	7	0
10	25	3	N	P	—	38	3	N	A	—	—	8	0	—	5	2
1905. 11	40	1	N	A	3 & 6	20	8	W	A	13	$DR \times \frac{R^*}{3}$	3	4	—	0	5
12	45	5	W	A	13	41	1	N	A	3 & 6	$\frac{R^*}{2} \times DR$	3	2	—	0	2
13	45	5	W	A	12	20	8	W	A	11	$\frac{R^*}{2} \times \frac{R^*}{3}$	0	3	—	—	1
14	41	8	W	A	—	19	2	W	A	8	$\frac{R^*}{3} \times \frac{R^*}{3}$	0	5	—	0	5

Feet.—W = Webbed foot. N = Normal feet.

"Shell."—P = Presence of "shell." A = Absence of "shell."

A discrepancy will be noticed between the numbers of birds illustrating the foot character and those which show presence or absence of "shell" in the same experiment. This is accounted for by the fact that it is possible to recognise the webbed or normal foot on hatching, or even in birds found dead in the egg-shell if sufficiently incubated, whereas the presence or absence of the "shell" can only be ascertained when the feathering of the young birds is fairly advanced.

It was noticed that many of the young birds which were webbed were extremely weakly in the nest, and several of them died at a very early age. Of the three extracted web-footed birds bred in Exp. 4 from the DR × DR mating, not one was reared. The extracted webbed birds whose purity was tested were all bred from the DR × R matings.

Discussion of Results.

Foot character.—It will be seen from the foregoing table that the feet of the F. 1 generation, of which six birds were bred, were all normal, the web character behaving as a recessive. Two pairs of F. 1 were mated, and in experiment 4 the webbed foot reappears in three birds out of the twelve, this being the exact proportion expected on the Mendelian hypothesis.

From the other pair (Exp. No. 3), however, *no recessives appeared*, and the mating was repeated in 1904, as Exp. 6, with the same result. During the two years that these birds were mated together 29 eggs were laid and 23 birds produced, all showing the normal foot character. The absence of webbed birds in this family was quite contrary to expectation, for 5 or 6 recessives were to be expected. In order to test the matter further, in 1905 the two F. 1 birds in question were mated to extracted recessives, and, as will be seen on referring to experiments 11 and 12, webbed and normal offspring were then obtained in approximately equal numbers in accordance with Mendelian expectations.

The absence of recessives in the 23 birds in F. 2, bred in experiments 3 and 6, is very remarkable. Whether it arose from any definite disturbing cause, or was merely a chance aberration, cannot be asserted. The behaviour of the same birds when mated to pure R clearly proves that their gametic production was then normal.

In the matings of DR's both with the original recessive web and with the extracted recessives the results are simple. It will be noticed that in experiments 2, 5, 11, and 12 fifteen webbed and fifteen normal birds were produced, the Mendelian expectation of such a mating being equality.

It being impossible to test the purity of webs bred by the DR × DR matings, as the birds died in the nest, the extracted recessives from the DR × R matings were used, and experiments 7, 8, 13, and 14 show the results. Nineteen birds were raised in these four experiments, all having the feet webbed.

TABLE II.

Exp. No.	Bird's No.	Left Foot	Right Foot

The table is rotated and contains dense numerical/fractional entries arranged under the headings **LEFT FOOT** and **RIGHT FOOT**, each subdivided into columns labelled D, iii, iv and their intermediate values (e.g. iii φ 3, iv φ 4, iv normal, etc.).

The row labels read:

Exp. No.	Bird's No.
2 …	58.
	19.
	30.
4 …	31.
	(1.)
5 …	(3.)
	(5.)
	23.
	45.
	88.
	109.
	110.
7 …	7.
	111.
	(8.)
8 …	(9.)
	(10.)
	90.
	41.
	42.
	60.
	85.
11 …	(11.)
	40.
	41.
	(16.)
12 …	(17.)
13 …	(14.)
	(15.)
	(18.)
14 …	(19.)
	(20.)
	510.
	511.
	589.
	540.
	560.

Variation in the Amount of Webbing.

I have stated that the webbed foot is subject to considerable fluctuation, both when the character is observed to occur in normal strains and when it appears as an extracted recessive in these experiments.

Table II. is arranged to show the approximate stretch of the web in the case of each bird recorded in the experiments. The observations were made by bending the foot and noting to which part of each digit the web was attached. In the table D stands for the digit, and ϕ for the phalanx. Unless otherwise stated, it should be understood that the web is attached to the distal end of the phalanx in question; but if a fraction is inserted after the number of the phalanx, then the web is attached halfway or three-quarters of the way up that phalanx. No very accurate means of measurement were applicable, and the estimations should be taken as approximate only.

The experiment numbers refer to Table I.

Brackets are placed round the number of a bird to signify that the bird died either in the egg-shell or very soon after hatching.

In all 37 web-footed Pigeons have been raised in the experiments, but upon such small numbers discussion of the relationship of the several graduations is impossible.

It may, however, be noted that some extremely small webs were raised in experiments 7 and 8, although the birds were bred from parents both showing the web character in a higher degree. Experiments 13 and 14 have already been discussed.

II. The Shell.

It will be seen from Table I. that this character behaves as a simple recessive throughout the experiments with the webbed strain (but *v. infra*).

In experiments 3, 4, and 6, out of the 29 birds bred, 6 show the "shell" in F. 2, a sufficiently close result.

The extracted recessives bred true, as shown in Exp. 9.

In Exp. 10 the number of recessives (5 : 2) is too high for a DR × R mating, which should have given equality, but the total is very small.

Further Experiments with "Shell."

The same Nun female which was used in the foregoing experiments was also mated to a Barb male.

There is no need to give here a description of the Barb beyond the statement that the feathers on the head are always smooth and no crest or "shell" is ever found.

The results of the mating of Barb ♂ and Nun ♀ are recorded in Table III.

TABLE III.

Exp. No.	♀.	Origin.	"Shell."	Also used in Exp.	♂.	Origin.	"Shell."	Also used in Exp.	Nature of Mating.	"Shell."	
										Present.	Absent.
1901. α ...	Nun	—	P	1 & γ	Barb	—	A	γ	R × D	2	2
1902. β ...	8	α	P	—	54	α	A	—	(? DR × DR)	2	1
1903. γ ...	Nun	—	P	1 & α	Barb	—	A	α	R × D	0	8
1904. δ ...	1	γ	A	—	3	γ	A	—	DR × DR	1	10

P = Presence of " shell."
A = Absence of " shell."

It will be noticed that as a result of the mating of Nun ♀ × Barb ♂ in Exp. α, a mixed generation was obtained as regards " shell " in F. 1. The two birds in which the " shell " was absent were ♂, the two in which it was present were ♀. It was thus impossible to test the " shelled " birds by mating together, and little or no clue is obtained as to their gametic constitution by Exp. β, as the numbers are so small. It may, however, be recorded that both the " shelled " females and one of the smooth-headed males were mated subsequently to smooth-headed birds which were crosses in F. 1 between a Barb and a Fantail. From these matings :

Barb Nun ♀ 8 (shell)   × Barb Fantail ♂ gave 8 young.
Barb Nun ♀ 18 (shell)   × Barb Fantail ♂ gave 5 young.
Barb Nun ♂ 54 (no shell)× Barb Fantail ♀ gave 6 young.

Of these 19 birds so produced, none had " shells."

In view of these results, which indicate that " shell " is a recessive character, the appearance of " shells " in the two females mentioned above is paradoxical. It is likely that this is some failure of dominance and that the birds were gametically DR's. A similar irregularity is recorded in the Report to the Evolution Committee of the Royal Society, ii. p. 114, as regards extra toe in fowls, which, though generally dominant, is sometimes recessive.

It was found inconvenient to follow up the experiment at the

time, but in 1903 the mating α was repeated in the experiment γ, in which the *identical birds* used in α were again mated together. In this experiment a uniform generation was obtained. A pair of birds bred in this F. 1 generation were mated together and the result is recorded in exp. δ.

The total results of the mating of Barb and Nun are:—

(Exp. α, γ) F. 1 : shell present 2 ; shell absent 10. ·
(Exp. β, δ) F. 2 : shell present 3 ; shell absent 11.

I can also mention here that two birds which were crosses, in the F. 1 generation, between a Nun and a Fantail, kindly sent to me by Miss Thiselton-Dyer, showed no trace of " shell." These birds were not bred from.

8. On a new Species of Worm of the Genus *Pontodrilus* from the Shores of the Red Sea. By FRANK E. BEDDARD, M.A., F.R.S., Prosector to the Society.

(Text-figures 78 & 79.)

The specimens of *Pontodrilus* upon which the following description is based were kindly placed in my hands by Mr. Cyril Crossland, F.Z.S. They were collected by that gentleman "in clean shell and coral sand on the shores of an islet in Khor Dongola, on the Soudan coast." Mr. Crossland further informed me that the worms " live about the highest level at which the sand is kept wet by the sea. As there is practically no rainfall the water in which they live is undiluted by rain almost always. A species of *Nereis* and some Crustacea share this habitat." There is thus no doubt about the purely marine surroundings of this *Pontodrilus*, which so far agrees with the majority of the species of the genus.

The general aspect of the worms was like that of the other species of *Pontodrilus* with which I am acquainted.

The length of the largest and fully mature example was 102 mm., the size being thus about the average size of the species of this genus.